RADIOCARBON DATES ON AND DEPOSITIONAL ENVIRONMENT OF THE WASAGA BEACH (ONTARIO) MARL DEPOSIT[1]

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ABSTRACT

Marl and carbonized organic material, deposited during the Nipissing Great Lakes stage, rests in direct superposition on lower Algonquin (Payette ? stage) beach gravels, at Wasaga Beach, Ontario. Five radiocarbon dates from the marl, (M-1024) 5840±350 B. P., (M-1025) 5270±350 B. P., (M-1026) 5740±250 B. P., (M-1027) 12,250±150 B. P., and (M-1028b) 20,000±2,000 B. P., vary widely and apparently show the effect of contamination by the addition of "dead" carbon from adjacent Paleozoic carbonate rocks. A sixth date, (M-1028a) 5120±400 B. P., obtained from a charcoal layer on top of the gravel, is believed to be correct and records a time near the end of the interval during which waters were rising to the Nipissing level from the preceeding low Stanley stage.

The marl deposit has yielded a molluscan fauna consisting of 22 species. The mollusks indicate a quiet, lacustrine environment, with abundant aquatic vegetation. Plant materials from these deposits were too highly degraded to provide much useful paleoecologic information.

INTRODUCTION

A very interesting series of abandoned shorelines near Wasaga Beach, Ontario, at the southeastern corner of Georgian Bay, has been described in detail by G. M. Stanley (1936). This series is particularly interesting because, at this locality, some of the lower Algonquin shorelines are present at altitudes *below* that of the Nipissing Great Lakes shoreline. The Nipissing shoreline formed much later in time than the lower Algonquin beaches and in most places, at the latitude of Wasaga Beach and farther south, these older beaches have been destroyed by Nipissing wave action. However, owing to the low relief of the area around Wasaga Beach, a strong Nipissing bar was built across the mouth of the embayment, forming a lagoon on its landward side. The quiet waters of the lagoon preserved the Payette (lower Algonquin) beach, although it was submerged by about ten feet of water (Stanley, 1936, figures 3 and 4). Marl deposits accumulated in this lagoon, apparently during the time of the Nipissing high water.

In May, 1959, the senior author, in the company of John J. Stephens and Fred Pessl, Jr., collected sediment samples and measured a section at this marl locality. It was hoped that these collections would provide some means of dating both the Nipissing and the underlying "Payette" deposits. At that time the marl-over-gravel section was still very similar to its photograph shown by Stanley (1936, pl. 4). The present report is based on these 1959 collections. Its purpose is to discuss the significance of the radiocarbon dates obtained from these materials, record the associated mollusk and plant remains recovered from the deposits, and present some inferences about the environment of deposition based on the sediments and fossils.

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MEASURED SECTION

Unit	*Description*	*Thickness* (ft.)
1	PLOW ZONE, organic matter mixed with marl	0.3
2	MARL, yellowish white, massive, mollusk shells common. (thickness varies between 1.0 and 2.0 ft. throughout pit).	1.8
	C—14 samples:	
	1st 6″ of marl below plow zone dated 5840±350 (M-1024)	
	next 4″ of marl dated 5270±350 (M-1025)	
	basal 3″ of marl dated 5740±250 (M-1026)	

Unit	*Description*	*Thickness* (ft.)
3	SILT, gray, marly gradational contact with marl above, sharp contact with gravel below	0.3
	C–14 sample of total sample dated 12,250±150 (M–1027)	
4	GRAVEL, dark gray to black owing to accumulation of organic matter, some charcoal fragments, some marl: this unit is the surficial zone of the gravel in unit 5.	0.1
	C–14 sample includes a little of base of unit 3: charcoal dated 5120±400 (M–1028a) marl fraction dated 20,000±2000 (M–1028b)	
5	GRAVEL, less than 1″ diameter pebbles, not well sorted (outwash? or wave-reworked outwash?), gradational below unit 4.	4.0

INTERPRETATION OF THE RADIOCARBON DATES

Units 1, 2, and 3 of this section constitute the Nipissing marl, and the underlying units 4 and 5 represent the uppermost part of the "Payette" gravel as identified by Stanley (1936). The radiocarbon dates cited in the section were determined by the University of Michigan—Memorial Phoenix Project Laboratory (Crane and Griffin, 1962, p. 184–185). Most are believed to show the effect of considerable contamination of the samples through the addition of "dead" carbon from the surrounding Paleozoic limestone terrain. Contamination was first suspected when the Nipissing marl samples yielded dates of from 5270 to 5840 years, instead of the expected age of about 4200–5000 years (see next paragraph), and it seemed to be confirmed by the difference between the apparent ages of the charcoal and carbonate fractions from unit 4. A contamination of about 2 to 18 percent of the marl by a contaminant entirely lacking in carbon-14 would be required to account for the discrepancy observed in the dates from unit 2. Nearly 60-percent contamination by "dead" carbon would be required to explain the 12,250 year date from unit 3 (contamination figures based on Olson, 1963, fig. 3). Only the date of 5120±400 years B.P., made on charcoal from unit 4, seems to be free of such contamination.

Previously the age of the Nipissing Great Lakes stage was believed to be approximately 4200 years B. P., based on radiocarbon-dated logs buried in pre-Nipissing beach deposits and on consideration of isostatic rebound (Farrand, 1962; Dreimanis, 1958). Recently this age has been contested and an age of 5000 to 6000 years has been proposed (Lewis, 1967, 1968; Lowdon, et al, 1967). The date of 5120 years B. P. from unit 4 is in good agreement with this new proposed age. Lewis (1968, p. 175) has noted that the North Bay-Mattawa River system, which served as an outlet during the interval in which water was rising to the Nipissing Great Lakes level, had been elevated to 605 feet above sea level and had essentially ceased to function as an outlet prior to 5,000 years B. P. The date of 5120 years B. P. from unit 4 is believed to represent a portion of the interval just prior to the time when the waters reached the level of the Nipissing Great Lakes. During this time the gravel of unit 5 was still emergent, thus permitting the accumulation and subsequent weathering of the organic layer comprising unit 4 (see report by Benninghoff below).

Assuming that the charcoal date of 5120±400 years B. P., from the top of the gravel layer, is the only correct date in this list, it seems reasonable to accept Stanley's interpretation of the overlying marl as a deposit of Nipissing age. The age of the underlying gravel, however, remains equivocal. The question is whether the charcoal fragments date the time of origin of the gravel deposit or a time when the organic material accumulated on the gravel surface after its deposition and were mixed with the gravel at a later date. The fact that the charcoal is conspicuous only in the uppermost inch of the gravel suggests that the charcoal was a later addition. If so, the gravel is most likely Payette in age, because its altitude at Wasaga Beach coincides with the projected profile of the Payette water plane (Stanley, 1936).

BIOTA AND ENVIRONMENT OF DEPOSITION OF THE WASAGA BEACH SECTION

Units 2, 3, and 4 were studied for pollen and other organic remains by W. S. Benninghoff who reports (letter, 18 July 1959):

> The samples contain very little pollen, in fact too little with which to make any useful interpretations. There are a few grains of pine, grass, maple, etc., so that I am confident the preparation techniques did not destroy other grains. There are numerous tests of protozoans (of the general type of *Arcella*) and fungal spores. These occur in a wide variety of lake sediments. The other organic material is highly degraded or humified. The woody material in the black organic layer [unit 4] was so strongly altered toward pure carbon that it reacted only slightly to acetolysis (which normally dissolved celluloses and hemicelluloses). This carbonization may have been the result of fire, but I wonder if it might have resulted from weathering at a soil surface. The materials at all depths in the deposit give evidence of the kind of humification and other soil processes that would occur where repeated wetting, drying, and aeration might take place. Cultivation of the soil surface would, of course, accelerate these processes.

The following mollusks from unit 2 were identified by the junior author. The University of Michigan Museum of Zoology catalogue number (UMMZ) and the number of specimens (in parentheses) follow each species. Fractions indicate the number of separate pelecypod valves. The sphaeriid material was verified and in some cases determined by H. B. Herrington.

PELECYPODA

Sphaerium lacustre (Müller)—UMMZ 210353 (4/2)
S. striatinum (Lamarck)—UMMZ 210354 (1/2)
S. simile (Say)—UMMZ 210355 (9/2)
Pisidium adamsi Prime—UMMZ 210356 (6/2)
P. compressum Prime—UMMZ 210357 (5/2)
P. ferrugineum Prime—UMMZ 210358 (5/2)
P. nitidum Jenyns—UMMZ 210359 (39/2)
P. variabile Prime—UMMZ 210360 (37/2)

GASTROPODA

Valvata tricarinata (Say)—UMMZ 210361 (227)
Amnicola limosa (Say)—UMMZ 210362 (144)
A. lustrica Pilsbry—UMMZ 210363 (28)
Lymnaea cf. *stagnalis jugularis* (Say)—UMMZ 210364 (2)
Stagnicola "palustris" (Müller)—UMMZ 210365 (4)
Fossaria cf. *dalli* (Baker)—UMMZ 210366 (1)
Helisoma anceps (Menke)—UMMZ 210367 (40)
H. trivolvis (Say)—UMMZ 210368 (1)
Gyraulus parvus (Say)—UMMZ 210369 (132)
Ferrissia parallela (Haldeman)—UMMZ 210370 (3)
Physa cf. *integra* (Haldeman)—UMMZ 210371 (9)
Pupoides albilabris (Adams)—UMMZ 210372 (1)
Nesovitrea electrina (Gould)—UMMZ 210373 (1)
Zonitoides arboreus (Say)—UMMZ 210374 (1)

The molluscan fauna consists of 22 species, representing 14 genera. The assemblage is dominated by aquatic species. Three specimens, *Pupoides albilabris*, *Zonitoides arboreus*, and *Nesovitrea electrina*, are the only terrestrial mollusks in the fauna.

A relatively silt-free, permanent lentic water situation is indicated by the abundance of the prosobranch gastropods *Valvata tricarinata*, *Amnicola limosa*, and *A. lustrica*, that together comprise 59 percent of the total number of individuals in the fauna. A lacustrine habitat is indicated by (1) the large number of the *Valvata tricarinata perconfusa* polymorph of *V. tricarinata*, which Baker (1928a,

p. 15) states is chiefly confined to lakes; (2) the presence of the lake form of *Amnicola lustrica* (Baker, 1928a, p. 107; Berry, 1943, p. 32); and (3) the occurrence of the large, smooth-shelled form of *Pisidium ferrugineum*, that is frequently found in lakes in which marl is accumulating (Herrington, 1962, p. 40). The preference of many of the species for a substrate of soft sediments indicates that, at least locally, the lake bottom consisted of a soft calcareous ooze.

The occurrence of *Sphaerium striatinum, Pisidium compressum*, and *Helisoma anceps*, species usually associated with moving water, probably indicates the presence of some current or wave action in portions of the lake. *Pisidium adamsi, P. variabile, Sphaerium lacustre, Ferrissia parallela, Stagnicola "palustris,"* and *Lynmaea stagnalis jugularis*, however, require a more sheltered situation, with little or no current action. This type of habitat might have existed in segments of the lake in which there were dense growths of aquatic vegetation, such as *Vallisneria, Potamogeton*, and *Chara*. This inference receives some support from the presence of *Sphaerium lacustre, Pisidium adamsi, Amnicola limosa, A. lustrica, Ferrissia parallela, Lymnaea stagnalis jugularis, Stagnicola "palustris"*, and *Valvata tricarinata*, species that appear to have a preference for habitats with considerable vegetal growth.

The three terrestrial species in the fauna are obviously allochthonous, and were probably washed into the lake. They may have lived contemporaneously with the acquatic species, or they may have been reworked from an older deposit.

With the exception of the terrestrial gastropods, and *Ferrissia parallela, Sphaerium lacustre*, and *Pisidium ferrugineum*, all of these species occur in the Recent fauna of Georgian Bay (Robertson, 1915; Heard, 1962). Examination of the collection of Recent mollusks at the University of Michigan Museum of Zoology revealed that at least two of these species, *S. lacustre*, and *P. ferrugineum* occur in some of the inland lakes in the area of Ontario adjacent to Georgian Bay. The depositional environment present at Wasaga Beach during the Nipissing Great Lakes stage was rather unique, because it permitted occupation of this area by species that are apparently not found in Georgian Bay at the present time. It is suggested that these special conditions were the result of the development of a bar across the mouth of the embayment at Wasaga Beach at this time. This barrier essentially isolated the water on the landward side of the bar, forming a lagoon in which the limnological conditions were probably quite similar to those now occurring in some of the sheltered, quiet-water, inland lakes of the same area today.

CONCLUSION

In summary, the marl deposits landward of the Nipissing bar at Wasaga Beach have yielded fossil mollusks which indicate a silt-free, quiet water, lacustrine environment. Plant materials, on the other hand, are too highly degraded to furnish much paleoecological information. The radiocarbon dates strongly suggest that much "dead" carbon has been incorporated into the marl, rendering all dates determined from samples of this material useless. Only the date (5120 ± 400) made on a sample of charcoal, which suggests a Nipissing age for the marl accumulation is considered to be dependable. The Payette age of the underlying gravel, although still quite reasonable, has not been unequivocally ascertained.

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